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The predictive role of Troponin I levels for mortality in geriatric patients transferred to the intensive care unit for COVID-19 pneumonia

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Abstract

Aim: Troponin I is an important prognostic marker in critically ill patients with COVID-19, similar to cytokines and other inflammatory mediators. The aim of this study was to evaluate the predictive value of troponin I levels for mortality in geriatric patients transferred to the intensive care unit for COVID-19 pneumonia according to age group.

Material and Methods: Seventy-four patients with COVID-19 pneumonia were grouped according to age (Group 1:65–74 years, Group 2: 75–84 years, and Group 3: ≥ 85 years) and retrospectively analyzed. Demographics, clinical findings, laboratory results upon admission to the intensive care unit, and outcomes were compared among the groups. Predictive value of troponin I levels upon admission to intensive care unit (Troponin Iicu), difference in troponin levels between general wards and intensive care unit (Troponin Idiff), C-reactive protein, ferritin, lactate dehydrogenase, neutrophil-to-lymphocyte ratio, procalcitonin, and D-dimer levels for mortality were also investigated.

Results: The mortality rate was 74.3% for the patients overall, and increased, albeit insignificantly, with increasing age. Neither Troponin Iicu nor Troponin Idiff was predictive for mortality for any of the age groups or for the patients overall. Ferritin, lactate dehydrogenase, neutrophil-to-lymphocyte ratio, and C-reactive protein levels were predictive for mortality for patients overall ($p= 0.016$, $p= 0.001$, $p= 0.013$, and $p < 0.001$, respectively).

Discussion: For geriatric patients, troponin I levels at the time of the first admission to the ICU are not sufficient to predict mortality alone and should be evaluated together with other parameters.

Keywords

COVID-19, Geriatrics, Intensive Care, Mortality

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Introduction

The 2019 novel coronavirus (COVID-19), which is still prevalent in high numbers across the world, is considerably challenging to treat in the intensive care unit (ICU). The early identification of severe forms of COVID-19 disease, and appropriate use of markers for prognosis, assist with patient management and reduce mortality [1]. While the COVID-19 infection is predominantly asymptomatic or is accompanied by mild symptoms, in nearly 15% of patients, infection can progress to acute respiratory distress syndrome (ARDS), multiorgan failure (MOF), or severe interstitial pneumonia, all of which are associated with high mortality rates [2]. Patients with advanced age, comorbidities, and those who develop ARDS during the course of their disease are at a greater risk of mortality [3]. The reported mortality rates among those with COVID-19 disease across all age groups is currently 2.3%, while for those aged 70-79 years, the mortality is 8% and for those aged ≥80 years, it reaches 14.8% [4]. Infectious diseases are a significant cause of mortality in patients aged > 65 years. Infections can be more severe in patients with advanced age due to dysfunction of the immune system, malnutrition, impaired mucosal function, or the loss of the cough reflex [3]. Furthermore, geriatric patients with COVID-19 infection have a more marked decrease in lymphocyte counts along with a greater increase in leukocyte counts and C-reactive protein (CRP) levels, which are associated with a worse prognosis [5].

In addition to pneumonia, patients with COVID-19 disease can develop cardiac complications, which include myocardial damage, arrhythmia, acute coronary syndromes, and venous thromboembolism, all of which worsen the prognosis [2]. Elevated troponin I and creatinine kinase levels, which indicate cardiac damage, can occur due to viral proteins, hypoxia, thrombosis, immune activation, subendocardial ischemia, and a severe disease course [6]. Similar to high levels of circulating cytokines and inflammatory mediators associated with an excessive immune response to COVID-19 infection, high troponin I levels are considered an important marker for worse prognosis and mortality [1,7].

In this retrospective study, we aimed to investigate the predictive value of troponin I levels for mortality in geriatric patients admitted to the ICU for COVID-19 pneumonia according to three age groups.

Material and Methods

This was a single-center retrospective study conducted between April 2020 and March 2021. A total of 74 patients aged ≥ 65 years who were treated in the ICU with positive polymerase chain reaction (PCR) tests for COVID-19 were included. Approval for this study was obtained from the local ethics board (2021/20). PCR assays for COVID-19 testing were performed on nasopharyngeal swab specimens. Patients without COVID-19 pneumonia, those aged < 65 years, and those with negative PCR results for COVID-19 were excluded. Patients were grouped according to age as follows: Group 1, aged 65–74 years; Group 2, aged 75–84 years; and Group 3, aged ≥ 85 years.

Demographic data (age, gender, comorbidities, Acute Physiology and Chronic Health Evaluation II [APACHE-II] scores, and thoracic computed tomography [CT] results before ICU admission), clinical data (symptoms, electrocardiogram and CT findings upon ICU admission, cardiovascular complications prior to ICU admission, need for mechanical ventilation [MV], need for vasopressors or inotropes in the first 24 h, duration of MV, length of ICU stay, and mortality), and laboratory blood test results upon admission to the ICU (hemoglobin, white blood cell count, lymphocytes, platelet count, neutrophil-to-lymphocyte ratio [NLR], CRP, procalcitonin [PCT], albumin, creatinine, aspartate transaminase [AST], alanine transaminase [ALT], lactate dehydrogenase [LDH], Interleukin-6, ferritin, fibrinogen, D-dimer, creatine kinase, creatine kinase-MB, high sensitive troponin I upon admission to the general ward [Troponin Iw], high sensitive troponin I upon admission to the ICU [Troponin Iicu], difference between troponin Iicu and troponin Iw [Troponin Idiff], ratio of partial arterial oxygen pressure to fraction of inspired oxygen [PaO2/FiO2], and lactate levels (from arterial blood gas results) were recorded. Interleukin-6 levels were not included in the study due to missing data. Patients were intubated and continued on invasive MV when hypoxia (peripheral oxygen saturation < 92% or PaO2 < 60 mmHg), tachypnea (respiratory rate ≥ 28/min), dyspnea, hemodynamic instability, or decreased consciousness developed despite treatment with non-rebreather reservoir bag oxygen mask, high-flow nasal oxygen therapy, or non-invasive MV. Vasopressor treatment was initiated when patients had hypotension (systolic blood pressure < 90 mmHg or mean arterial pressure < 65 mmHg) despite fluid administration.

The data were compared among the groups. The sensitivity and specificity of Troponin Iicu, Troponin Idiff, CRP, ferritin, LDH, NLR, PCT, and D-dimer levels were analyzed to evaluate their predictive value for mortality in geriatric patients according to age group.

Statistical Analysis:

Statistical analyses were performed using SPSS version 23 (IBM Corp., Armonk, NY, USA) and MedCalc version 16 (MedCalc Software bvba, Ostend, Belgium). Descriptive statistics were presented as the number (n) and percentage (%) for categorical variables, and as median and interquartile range (IQR) for numerical variables. The Pearson chi-square test and Fisher's exact test were used to compare categorical variables, and the Kruskal-Wallis test was used to compare numerical variables among the study groups according to age group. Dunn's post-hoc tests were carried out for pairwise comparisons. A receiver operating characteristic (ROC) analysis was used to predict the diagnostic accuracy of Troponin Iicu and Troponin Idiff, ferritin, CRP, LDH, D-dimer, NLR, PCT, and fibrinogen levels in predicting mortality. The area under the ROC curves (AUCs) with 95% confidence intervals (CIs) for Troponin Iicu, Troponin Idiff, ferritin, and CRP were calculated using the method proposed by Delong et al [8]. The Youden J index was used to predict the best cut-off values. Sensitivity and specificity with 95% CIs were calculated. Statistical significance was set at $p < 0.05$.

Results

We retrospectively reviewed 115 patients during the study period. After excluding 41 patients according to the inclusion and exclusion criteria, 74 patients were included in this study. Table 1 presents the patients' demographics and clinical features

Table 1. Demographics and clinical features before ICU admission, ICU outcomes according to age group

Characteristics	Age group			Total	p
	65–74 years (n=27)	75–84 years (n=25)	≥ 85 years (n=22)		
Female/Male n (%)	13/14 (48.1/51.9)	13/12 (52/48)	12/10(54.2/45.5)	38/36(51.4/48.6)	0.903
APACHE 2 score, median (IQR)	17.0 (11.0-25.0)	20.0(18.0-26.0)	22.5 (15.0-29.3)	19.5 (15.0-26.0)	0.053
Comorbid conditions,n (%)					
Hypertension	18 (66.7)	16 (64.0)	18 (81.8)	52 (70.3)	0.360
DM	11 (40.7)	9 (36.0)	8 (36.4)	28 (37.8)	0.926
CAD and CHF	4 (14.8)	6 (24.0)	7 (31.8)	17 (23.0)	0.367
COPD	9 (33.3)	5 (20.0)	3 (13.6)	17 (23.0)	0.241
Stroke history	4 (14.8)	2 (8.0)	3 (13.6)	9 (12.2)	0.745
Dementia	2 (7.4)	8 (32.0)	8 (36.4)	18 (24.3)	0.035
Renal failure	5 (18.5)	9 (36.0)	4 (18.2)	18 (24.3)	0.247
Malignancy	4 (14.8)	5 (20.0)	0 (0.0)	17 (23.0)	0.074
Sign and symptoms, n (%)					
Fever	4 (14.8)	5 (20.0)	2 (9.1)	11 (14.9)	0.601
Chest pain	1 (3.7)	2 ((8.0)	0 (0.0)	3 (4.1)	0.636
Hypoxia and dyspnea	27 (100.0)	25 (100.0)	21 (95.5)	73 (98.6)	0.074
Diarrhea	5 (18.5)	2 (8.0)	0 (0.0)	7 (9.5)	0.108
Reduced GCS (with or without dyspnea)	6 (22.2)	14 (56.0)	10 (45.5)	30 (40.5)	0.040
Acute thromboembolic events, n (%)					
Stroke	1 (3.7)	1 (4.0)	1 (4.5)	3 (4.1)	0.999
PE	0 (0.0)	1 (4.0)	1 (4.5)	2 (2.7)	0.530
ACS/MI	0 (0.0)	3 (12.0)	1 (4.5)	4 (5.4)	0.146
ECG findings at ICU admission, n (%)					
Sinus tachycardia	18 (66.7)	13 (52.0)	9 (40.9)	40 (54.1)	0.192
Atrial fibrillation	4 (14.8)	6 (24.0)	7 (31.8)	17 (23.0)	0.367
ST-T abnormality	2 (7.4)	1 (4.0)	1 (4.5)	4 (5.4)	0.999
Ventricular extrasystole	0 (0.0)	0 (0.0)	3 (13.6)	3 (4.1)	0.024
CT features, n (%)					
Bilateral GGO, n (%)	25 (92.6)	22 (88.0)	19 (86.4)	66 (89.2)	0.807
Unilateral GGO, n (%)	1 (3.7)	2 (8.0)	2 (9.1)	5 (6.8)	0.730
Pleural effusion (with or without infiltration), n (%)	3 (11.1)	5 (20.0)	6 (27.3)	14 (18.9)	0.345
ICU outcomes					
IMV in the ICU, n (%)	21 (77.8)	24 (96.0)	20 (90.9)	65 (87.8)	0.136
Duration of IMV in the ICU, median (IQR) (days)	8.0 (2.0-13.0)	10.0 (5.5-32.0)	7.0 (2.0-23.2)	8.5 (3.0-15.0)	0.279
NFV in the first 24 h	7 (25.9)	16 (64.0)	12 (54.5)	35 (47.3)	0.016
Length of ICU stay, median (IQR) (days)	9.0 (6.0-14.0)	11.0 (5.5-32.5)	10. (5.0-23.3)	10.0 (5.8-17.3)	0.658
Mortality	19 (70.4)	18 (72.0)	18 (81.8)	55 (74.3)	0.625

ICU: Intensive care unit, CAD: Coronary artery disease, CHF: Congestive heart failure, DM: Diabetes Mellitus, COPD: Chronic obstructive pulmonary disease, GCS: Glasgow coma scale, APACHE 2: Acute Physiology and Chronic Health Evaluation 2, ECG: Electrocardiogram, DVT: Deep venous thrombosis, PE: Pulmonary embolism, ACS/MI: Acute coronary syndrome and/or myocardial infarction. CT: computed tomography, GGO: Ground glass opacity, IMV: Invasive mechanical ventilation, NFV: Need for vasopressors or inotropic drugs in ICU.

before admission to the ICU and ICU outcomes. The median age was 78 years, with an IQR of 70–85 years, and 51.4% of the patients were female. The presence of dementia significantly increased with age (p = 0.035), and a low Glasgow coma scale was observed statistically less frequently in those aged between 65 and 74 years (p = 0.040). The distribution of acute thromboembolic events during follow-up in the ward was similar among the groups. Ventricular extrasystoles were observed only in three patients, all aged ≥ 85 (p = 0.024). CT features were statistically similar among the groups, and bilateral ground-glass opacities were the most common finding. Concerning the patients' ICU outcomes, the need for vasopressors or inotropic drugs in the first 24 h of ICU admission was significantly lower in the group aged 65–74 years than in the other age groups (p = 0.016). The mortality rate of the patients overall was 74.3%, and while there was an increase in fatality in the older age group, the difference between the groups was not statistically significant. The cause of death in patients overall was severe ARDS, and acute cardiac complications were not the primary cause of mortality (Table 1).

All laboratory parameters, except for LDH, were statistically similar between the groups. However, there were significant differences in LDH levels between the groups (p = 0.023). In the post-hoc pairwise comparisons, we found a statistically significant difference in LDH levels between the group aged 75–84 years and the group aged ≥ 85 years (p = 0.024), (Table 2).CRP was a statistically significant predictor of mortality for each age group and for the patients overall (p = 0.001, p = 0.008, p = 0.008, and p < 0.001, respectively). Additionally, ferritin was a statistically significant predictor of mortality for those aged 65–74 years and for the patients overall (p = 0.002 and p = 0.016, respectively). However, neither Troponin Iicu

Table 2. Patients' laboratory findings according to age group

Laboratory findings, median (IQR)	Age group			Total	p
	65–74 years (n=27)	75–84 years (n=25)	≥ 85 years (n=22)		
Hb (g/dL)	12.0 (9.6-13.0)	12.3 (10.9-13.2)	11.0 (9.0-12.1)	11.8 (9.8-12.8)	0.186
WBC (103/mm3)	10.6 (7.3-14.0)	11.8 (9.2-16.7)	10.5 (8.5-18.2)	11.3 (8.3-16.0)	0.932
Lymphocytes (103/mm3)	0.7 (0.5-1.0)	0.6 (0.4-1.0)	0.8 (0.5-1.1)	0.7 (0.4-1.0)	0.600
Platelets (103/mm3)	236.0 (194.0-320.0)	216.0 (170.0-292.0)	229.5 (172.0-284.5)	228.5 (172.8-293.3)	0.596
NLR	14.3 (5.8-29.6)	16.3 (9.9-26.3)	13.9 (6.9-35.8)	15.3 (8.1-29.7)	0.685
CRP (mg/L)	17.6 (10.5-32.0)	17.7 (10.8-35.7)	14.9 (10.7-18.4)	16.5 (10.8-24.2)	0.421
PCT (µg/L)	0.40 (0.17-1.13)	0.74 (0.17-5.69)	0.37 (0.10-0.96)	0.44 (0.13-2.36)	0.312
Albumin (g/dL)	3.1 (2.6-3.4)	2.8 (2.5-3.3)	3.1 (2.4-3.4)	3.1 (2.5-3.3)	0.901
Creatinine (mg/dL)	1.1 (0.7-1.4)	1.3 (0.8-3.4)	1.1 (0.9-1.7)	1.1 (0.8-1.7)	0.255
AST (U/L)	40.0 (24.0-61.0)	43.0 (28.5-68.0)	35.5 (23.3-51.3)	39.0 (24.0-59.0)	0.597
ALT (U/L)	27.0 (17.0-71.0)	29.2 (14.5-51.0)	21.6 (10.0-34.3)	27.7 (14.0-40.5)	0.36
LDH (U/L)	469.0 (260.0-636.0)	503.0 (312.5-630.5)	320.0 (207.0-422.8)	447.5 (257.5-576.0)	0.023
Ferritin (ng/mL)	434.5 (314.0-1328.5)	787.0 (328.8-1972.5)	473.0 (242.7-894.0)	612.0 (314.0-1246.0)	0.266
Fibrinogen (mg/dL)	592.0 (512.0-719.0)	566.0 (527.0-728.0)	567.0 (470.5-695.5)	576.0 (507.0-711.8)	0.723
D-dimer (mcg/mL)	1.81 (0.96-4.15)	2.19 (1.41-4.49)	1.77 (1.20-3.68)	2.03 (1.16-3.88)	0.631
CK (U/L)	109.0 (32.0-213.5)	162.5 (84.8-341.5)	198.0 (54.0-455.0)	129.0 (54.3-313.0)	0.332
CK-MB (%)	2.4 (1.3-3.8)	3.1 (1.1-10.6)	2.8 (1.6-7.3)	2.7 (1.4-5.9)	0.282
Troponin Iw (pg/mL)	10.8 (10.0-29.4)	28.3 (10.9-95.2)	25.8 (10.9-74.5)	15.5 (10.0-57.4)	0.078
Troponin Iicu (pg/mL)	18.9 (10.0-98.7)	57.1 (10.3-188.7)	64.3 (27.5-308.8)	40.3 (12.2-160.5)	0.097
Troponin Idiff (pg/mL)	3.7 (0.0-91.5)	5.9 (-0.2-51.1)	10.9 (-2.3-159.5)	7.4 (0.0-84.0)	0.970
PaO2/FiO2	82.0 (65.5-144.8)	93.0 (70.0-113.5)	92.5 (79.0-133.0)	89.0 (70.0-127.8)	0.692
Lactate (mmol/L)	1.80 (1.20-2.33)	1.65 (1.50-2.40)	1.80 (1.28-2.28)	1.70 (1.30-2.38)	0.820

Hb: Hemoglobin, WBC: White blood cell count, NLR: Neutrophil-to-lymphocyte ratio, CRP: C-reactive protein, PCT: Procalcitonin, LDH: Lactate dehydrogenase, AST: Aspartate transaminase, ALT: Alanine transaminase, CK: Creatine kinase, CK-MB: Creatine kinase MB isoenzyme, Troponin Iw: Troponin I level in the general ward, Troponin Iicu: Troponin I level in the ICU , Troponin Idiff: Difference between troponin I level in ICU and general ward, PT: Prothrombin time, PaO2/FiO2: Partial arterial oxygen pressure/Fraction of inspired oxygen.

Table 3. Comparison of AUCs and ROC analysis results of laboratory test parameters for predicting mortality according to age group

Outcome	Age group	Test	AUC (95% CI)	p	Cut-off	Sensitivity (95% CI)	Specificity (95% CI)
Mortality	65–74 y	Troponin Iicu	0.602 (0.384-0.794)	0.440	≤ 136.7	87.5 (61.7-98.4)	37.5 (8.5-75.5)
		Troponin Idiff	0.500 (0.291-0.709)	0.999	> 171	0.0 (0.0-20.6)	62.5 (24.5-91.5)
		Ferritin	0.813 (0.602-0.941)	0.002	> 322	87.5 (61.7-98.4)	75.0 (34.9-96.8)
		CRP	0.805 (0.593-0.936)	0.001	> 18.3	62.5 (35.4-84.8)	100.0 (63.1-100.0)
	75–84 y	Troponin Iicu	0.681 (0.445-0.864)	0.294	≤ 167	81.2 (54.4-96.0)	60.0 (14.7-94.7)
		Troponin Idiff	0.738 (0.456-0.933)	0.326	≤ 8	68.8 (41.3-89.0)	80.0 (28.4-99.5)
		Ferritin	0.688 (0.451-0.869)	0.288	> 789	62.5 (35.4-84.8)	80.0 (28.4-99.5)
		CRP	0.775 (0.543-0.926)	0.008	> 17.4	62.5 (35.4-84.8)	100.0 (47.8-100.0)
	≥ 85 y	Troponin Iicu	0.625 (0.390-0.823)	0.487	> 53.9	64.7 (38.3-85.8)	75.0 (19.4-99.4)
		Troponin Idiff	0.522 (0.296-0.741)	0.901	≤ 27.9	23.5 (6.8-49.9)	100.0 (39.8-100.0)
		Ferritin	0.500 (0.277-0.723)	0.999	> 657	47.1 (23.0-72.2)	75.0 (19.4-99.4)
		CRP	0.772 (0.539-0.924)	0.008	> 14.8	64.7 (38.3-85.8)	100.0 (39.8-100.0)
	All patients	Troponin Iicu	0.543 (0.415-0.666)	0.633	≤ 167	79.6 (65.7-89.8)	41.2 (18.4-67.1)
		Troponin Idiff	0.595 (0.467-0.715)	0.279	≤ 250	98.0 (89.1-99.9)	29.4 (10.3-56.0)
		Ferritin	0.684 (0.558-0.793)	0.016	> 415	69.4 (54.6-81.7)	70.6 (44.0-89.7)
		CRP	0.767 (0.646-0.862)	<0.001	> 17.4	59.2 (44.2-73.0)	94.1 (71.3-99.9)

Troponin Iicu: Troponin I level in ICU, Troponin Idiff: Difference between troponin I level in ICU and general ward, CRP: C-reactive protein.

nor Troponin Idiff was a statistically significant predictor of mortality for any of the age groups or for the patients overall (Table 3).

We also analyzed other laboratory parameters, such as LDH, D-dimer, NLR, PCT, and fibrinogen, to predict mortality in the ICU. We found that LDH and NLR were statistically significant predictors of mortality for patients overall (AUC [95% CI]: 0.726 [0.610-0.823], p = 0.001 and 0.675 [0.556-0.779], p = 0.013, respectively), (data not shown).

Discussion

In our study, we evaluated the predictive value of troponin I levels, along with other laboratory parameters, at ICU admission for mortality in geriatric patients with COVID-19 requiring ICU treatment according to age group. The predictive value of Troponin Iicu levels and Troponin Idiff levels were both limited. Ferritin, LDH, NLR, and especially CRP performed better as predictive markers for mortality in this patient group.

COVID-19 infections are associated with higher levels of CRP,

NLR, AST, direct bilirubin, LDH, urea, creatinine, ferritin, D-dimer, and more profound lymphopenia than other viral infections. When secondary infections are present, PCT levels also increase [9,10]. Patients who require ICU treatment have higher levels of these parameters, along with higher levels of circulating cytokines, which are representative of the severity of acute lung injury and prognosis [10]. The majority of our patients had lymphocytopenia, leukocytosis, and elevated NLR, CRP, LDH, ferritin, fibrinogen, and D-dimer levels at ICU admission. When these parameters were compared across age groups, only LDH levels showed significant differences. LDH is found in many tissues, including the myocardium, reticuloendothelial system, lungs, kidneys, pancreas, liver, and striated muscles in the form of different isoenzymes and is released with tissue damage resulting from severe infections. LDH levels are expected to be elevated in patients with COVID-19 infections with severe interstitial pneumonia, which often results in ARDS, and increase with the severity of disease independent of age [11]. In our study, however, LDH levels were not higher in elderly patients compared to other age groups. This difference in LDH could have been caused by the less frequent observation of bilateral widespread pneumonia in the advanced age groups compared to other age groups in our study.

Bilateral pulmonary infiltrations (bilateral widespread ground-glass opacities on CT) were present in 89.2% of our patients, and although statistically insignificant, the frequency decreased with increasing age. All study patients had severe ARDS with a PO2/FiO2 < 200. The MV requirement and mortality were not significantly lower in patients aged < 75 years compared to the other age groups. Advanced age is independently associated with worse prognosis due to pathophysiological changes in the respiratory system. Higher mortality rates are reported for patients aged > 80 years compared with younger patients [5]. In the general population, 5% of COVID-19 cases develop severe pneumonia requiring ICU treatment. Approximately 42%–100% of these patients progress to ARDS, which requires invasive MV and is associated with a 50%–60% mortality rate [12,13]. Bozal et al. reported a 94.7% mortality rate in geriatric COVID-19 patients admitted to the ICU [14]. The time between onset of symptoms and ICU admission was shorter with increasing age. Although not statistically significant, this finding showed faster deterioration with increasing age. Among the patients in our study, overall, 87.8% required invasive MV during their ICU stay, and the mortality rate was 74.3%, with a higher rate in patients aged ≥ 85 years.

There is a potential relationship between disease severity and cardiac injury in patients with COVID-19 infection. Elevated troponin levels, indicative cardiac injury may be due to direct myocardial infiltration or non-ischemic causes, such as hypoxia, sepsis, or the cytokine storm associated with elevated inflammatory biomarkers [15,16]. Zhon et al. have associated leukocytosis, high levels of ALT, LDH, creatine kinase, D-dimer, ferritin, PCT, and interleukin-6, as well as highly sensitive cardiac troponin I, with worse prognosis and mortality [17]. Santoso et al. have shown that higher troponin levels are associated with increased mortality, a higher rate of ICU admissions, and more severe COVID-19 infection [7]. We observed an increase in troponin I levels with clinical worsening and transfer to the ICU from the general wards. While there were no significant differences in troponin I or creatinine kinase levels at ICU admission between the different age groups, these parameters were higher in patients aged ≥ 75 years. The need for inotropic support within the first 24 h of ICU admission was notably higher with increasing age. When troponin I levels and mortality were analyzed, Troponin Iicu levels and Troponin Idiff levels did not significantly predict mortality.

Arrhythmias can arise from the myocardial effects of severe COVID-19 infection [18]. Chen et al. reported that sinus tachycardia, not associated with body temperature or oxygen saturation, was the most frequent type of arrhythmia, especially in severe cases, and ventricular tachycardia, atrioventricular block, and atrial fibrillation were also associated with clinical worsening [19]. Consistent with previous studies, the most frequent arrhythmia found in our patients was sinus tachycardia. Atrial fibrillation and ventricular tachyarrhythmias were more frequent in patients aged ≥ 85 years.

Levels of CRP, which is an acute-phase reactant, increase with the severity of infection [20]. Arslan et al. have demonstrated that high CRP levels are indicative of worse prognosis and mortality in geriatric patients with sepsis [21]. Liu et al. found that higher CRP levels in geriatric patients compared to young and middle-aged patients were consistent with a worsening prognosis with age [22]. In their study on COVID-19 patients aged 61-75 years, Pan et al. found that SpO2, lymphocyte count, PCT, D-dimer, LDH, and CRP levels were predictive of prognosis in critically ill patients [12]. In our study, we observed that Ferritin, LDH, NLR, and especially CRP may be a more significant parameter than Troponin I in the prediction of mortality in geriatric patients upon admission to the intensive care unit.

There are some limitations to our study. First, due to the lack of data, we could not evaluate the relationship between trends in troponin I levels over the course of a patient's ICU stay and outcomes. Therefore, our study did not include an analysis of changes in troponin levels as a predictor of mortality. Second, the number of patients was limited due to the retrospective nature of the study and the focus on a specific patient group. This may help explain why differences between the age groups did not reach statistical significance.

In conclusion, geriatric patients admitted to the ICU with severe COVID-19 pneumonia have a worse course of pulmonary disease, more frequent hemodynamic instability, and a worse prognosis with increasing age. For these patients, troponin I levels at the time of first admission to the ICU are not sufficient to predict mortality alone and should be evaluated together with other parameters.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest
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